

## TRANSLATION

METAL CONTINUOUS CASTING APPARATUS, ESPECIALLY FOR STEEL MATERIALS,  
FOR THE PRODUCTION OF ELONGATED PRODUCTS IN A MULTISTRAND CASTING  
PLANT

5           The invention relates to an apparatus for the continuous  
casting of metals, especially steel materials, to elongated  
products in a multistrand casting plant [multiple casting plant],  
with several strand casting molds, each of which is mounted to  
oscillate separately in an oscillating frame which is driven to  
10 oscillate in the casting direction by plate or leaf spring pairs on  
both sides of the cast strand and which extend transversely to the  
casting direction for guiding and weight compensation on a base  
frame.

15           From EP 0 468 607 B2, a liquid-cooled mold for the  
continuous casting of metals is known, with which billet-shaped,  
bloom-shaped and round strands can be cast by means of a tubular  
mold. For that purpose the mass of the mold depends upon the  
particular strand format or shape and is determined based thereon  
so that for a slab format or shape the mold can weigh about 30  
20 metric tons while the weight of a mold for round or rectangular  
cross section strands can be about 1.3 to 2.5 tons. With the  
reduction of mold weight, higher oscillation numbers (oscillations

per unit time) can be reached with the smallest utilization of applied force.

The present invention is concerned however with so-called multiple casting units, i.e. multiple strand casting plants, in which a plurality of cast strands are produced simultaneously alongside one another. With such multistrand casting plants, it is desirable to have the smallest possible strand spacing or interstrand spacing from cast strand to cast strand as measured from mold center to mold center. For newly constructed continuous casting plant, such multistrand casting systems reduce the cost of producing the product and with conversion of single strand plants to multistrand plants, the capital cost for such production can be reduced as well. At the same time in such conversions, stirring or agitation coils which can have an inductive effect on the liquid core of the cast strand, can be incorporated as well.

It is the object of the invention to provide in continuous casting plants, also with so-called resonance molds, as described at the outset and whose significant feature is a leaf spring casing or unit or stack, the smallest possible strand spacing between the cast strands.

This object is achieved in accordance with the invention in that in an apparatus as described at the outset, on an elongated base frame and in the strand travel direction the compact flat-cassette housings are secured in which the upper and lower leaf spring pairs run transversely to the cast strands and upon which the oscillating drive act on the leaf spring pairs whereby a front

oscillating drive operates synchronously with the rear oscillating drive. The advantage in such a transverse arrangement with a crossing of the cast strand by comparison with prior longitudinal arrangements is a significant place and space saving so that the distance from cast strand to cast strand can be held as small as possible. The arrangement of the flat cassettes one behind the other with the respective oscillating drives in the casting direction and a crossing transverse arrangement of the plate or leaf spring transverse to the casting axes or the casting strands enables the formation of a sufficiently large space for the continuous casting mold to be built in between the two flat cassettes. At the same time sufficient free space is obtained for the incorporation of a so-called zero support roll segment. Close to the entire strand spacing "A" can thereby be used.

According to further features it is proposed that the front oscillation drive be adjusted with respect to the rear oscillation drive with different strokes for an arcuate pattern of the casting strands. In that case, the rear oscillation drive can be set to a higher stroke relative to the front oscillation drive.

Another advantage resides in that the oscillation drives may be comprised of hydraulic drive units. The oscillation drives can be arranged in protected space below the base or foundation frame.

Further features include that the flat cassettes are comprised of two rectangular frames disposed one behind the other in the strand travel direction and each of which has two plate

spring or leaf spring pairs of plate or leaf springs spaced apart in their heights, and that between the rectangular frames, a mold-seating frame is surprisingly arranged. In this manner the two rectangular frames can simultaneously form a guide for the mold receiving frame.

The special protection for the drives can be achieved by locating the oscillating drive units each in the median plane of the continuous strand below the two rectangular frames and between longitudinal beams of the base or foundation frame. Apart from a protected location, this arrangement provides advantages in attachment location.

Other features include that the foundation or base frame can have suspension elements between the longitudinal beam and upon which the suspenders for a support or guide roll segment can be mounted. In this manner the introduction of a support or guide roll segment prior to mounting of the continuous casting mold can be facilitated.

In a further feature it is provided that the suspension elements comprise a double-arm lever rotationally journaled on the longitudinal beams and a suspension trough formed at one lever end and an adjustment device on another lever end.

The configuration of the apparatus can be further developed in that a water clamping plate for supplying the continuous casting mold with cooling medium can be disposed on the rear flat cassette and in that the cooling medium feed and the

cooling medium discharge run away from the casting strand rearwardly.

In the drawing, embodiments of the invention have been illustrated which are described in greater detail hereinafter.

5           The drawing shows:

FIG. 1   a perspective view of the apparatus in an overall illustration,

FIG. 2   a perspective view according to FIG. 1 without the protective covering,

10          FIG. 3   a side view in a vertical plane without the first casting strand,

FIG. 4   a plan view of the apparatus,

FIG. 5   a front elevational view of the apparatus with the protective covering removed, and

15          FIG. 6   a bottom plan view of the apparatus.

20          In a multistrand casting plant or operation (FIG. 1) with a multiplicity of cast strands 3 running parallel to one another in the casting direction 1, for each of the cast strands, there is a continuous casting mold (not shown) and a support roll frame in a segmental configuration (not shown), configured to produce longitudinal products like for example billets, blooms (pre-ingots), round cross sections or profile cross sections alongside one another. Each of the continuous casting molds is mounted

separately in an oscillating frame 2 driven to oscillate in the casting direction 1. Each oscillating frame 2 is connected by means of plate or leaf springs 4 (FIG. 2) with the respective continuous casting mold or to the mold table. The oscillating movement is effected in the casting direction 1 as a sinusoidal movement. Usually a greater velocity of the continuous casting mold is provided during the rearward movement of the mold than is the speed of the cast strand 3. The oscillating frequency and the magnitude of oscillation are matched to one another. The leaf spring or plate spring pairs 4a and 4b extend transversely to the casting direction 1 and cross the cast strand 3 and serve to guide and for weight compensation of the continuous casting mold on a base frame 5.

So that a plurality of cast strands 3 or casting lines can be provided to adjoin one another as closely as possible, that is to achieve a spacing A which is as small as possible (FIG. 1), each foundation frame 5 is formed as an elongated rectangle in the continuous casting direction. The base frame 5 is respectively formed from longitudinal beams 5a and 5b.

At the rear end and at the front end of the base frame 5 there are respective compact flat cassettes 6 which extend in their respective longitudinal directions transversely to the casting lines 3 and bridge the space between the two longitudinal beams 5a and 5b. Each flat cassette 6 is comprised of a closed housing 6a, whereby a rear flat cassette 6b and a front flat cassette 6c define a space between them for receiving a continuous casting mold.

Each flat cassette 6 is formed by the housing 6a together with protective covers 7 on both sides. Within the housing 6a are base frames 8, two of which are provided parallel to one another and spaced apart, together with the leaf springs or plate springs which will be described in greater detail hereinafter and are formed as upper and lower plate springs or leaf spring pairs 4a and 4b transverse to the longitudinal direction and which form articulations. Between the two base frames 8 of each cassette 6, a water clamping plate 9 is provided for the cooling of the continuous casting mold and is connected from below with a cooling medium supply 10.

The configuration of each flat cassette 6 with its housing 6a open, that is with the cover protectors 7 removed, has been shown. In each flat cassette 6, that is in each case two pairs of upper plate spring pairs 4a and lower plate spring pairs 4b are associated with an oscillating drive 11 acting on or fastened to a bridge 12 connecting the upper and lower pairs of springs. The front oscillating drive 11a and the rear oscillating drive 11b which together form the oscillating drive 11 are synchronized to effect an arcuate travel 13 of the strands with unequal strokes but the same frequency. The oscillating drives 11a and 11b are for example configured as hydraulic oscillating drive units 14 which are fed by hydraulic lines 15.

As can also be seen from FIG. 2, each flat cassette 6 which is comprised of the two parallel rectangular frames 16 lying one behind the other in the casting direction 1 (FIG. 1) has the

respective plate or leaf spring pairs 4a, 4b of each frame 16 spaced apart at different heights, with the frames 16 of each cassette receiving between them respective mold support frames 17 to oscillate with the respective bridge 12 as actuated by the  
5 respective drive 11a, 11b. Each of the mold support frames 17 has two mold support surfaces 18 at their ends.

The oscillation drive units 14 are located in the median plane 19 (FIG. 1) of the casting lines 3 below two rectangular frames 16 and between the longitudinal pairs 5a, 5b of the  
10 foundation frame.

According to FIGS. 1 and 2, between the longitudinal beams 5a, 5b, suspension elements 20 are mounted upon which a support roll segment (not further illustrated) can be suspended and which receives the cast stands 3 and their travel below the  
15 continuous casting mold. The suspension elements 20 are comprised of a double-arm lever 21 pivotally mounted on the longitudinal beams 5a, 5b and which has at one lever end 21a a suspension trough 22 (FIG. 3) and on the other lever end 21b an articulation to an adjusting device 23 with which the exact position of the suspended  
20 support roll segment can be set.

According to FIG. 3 and in combination with FIG. 4 there is shown the water clamping plate 9 for the rear flat cassette 6b which supplies the continuous casting mold with the cooling medium. In addition, apparent from these illustrations is the fact that the  
25 cooling medium feed 10 and the cooling medium discharge 24 run



rearwardly from the rear side of the device and therefore the side turned away from the hot cast strands 3.

In the plan view of FIG. 4, the cooling medium supply 10 and the cooling medium discharge 24 on the two sides, and in addition, the hydraulic lines 15 for the oscillating drive 112 have been shown. Each of the compact flat cassettes 6 contains two base frames 5 and between these base frames the respective oscillating frame 2 is disposed. In addition, the four mold support surfaces 18 are visible. It is also possible to see in this Figure the adjusting devices 23 for the double-arm levers 21 with their suspension troughs 22.

In the front view of FIG. 5, with the protective cover 7 removed, a base frame 8 can be seen in detail with its upper leaf spring or plate spring pair 4a and its lower leaf spring or plate spring pair 4b is connected to the connection bridge 12. In addition, the view is directed perpendicularly to the oscillating drive 11 whose hydraulic lines 15 can be seen. The rectangular frame configuration 16 [of the base frame 8] extends slightly beyond the mold receiving frame 17 [of the respective oscillating frame 2] with its mold support surfaces 18. The cooling medium feed 10 and the cooling medium discharge 24 are arranged at the rear side of the device.

In the plan view from below, FIG. 6, the hydraulic oscillating drive units 24 are visible from below. In addition, the eye can form on the hydraulic lines 15 which lie on both sides of the foundation frame 5 with the longitudinal beams 5a and 5b.

In addition, the adjusting devices 23 (with the suspension troughs 22 not visible here) for a support roll segment are visible from below.

#### Reference Character List

5	1	Casting direction, strand travel direction
	2	Oscillating frame
	3	Cast lines, casting strand
	4	Leaf or plate spring
	4a	Upper leaf or plate spring pair
10	4b	Lower leaf or plate spring pair
	5	Foundation frame
	5a	Longitudinal beam
	5b	Longitudinal beam
	6	Compact flat cassette
15	6a	Housing
	6b	Rear flat cassette
	6c	Front flat cassette
	7	Protective cover
	8	Base frame
20	9	Water clamping plate
	10	Cooling medium feed
	11	Oscillating drive
	11a	Front oscillating drive
	11b	Rear oscillating drive

- 12 Connecting bridge
- 13 Arcuate path of the cast strand
- 14 Hydraulic oscillating drive unit
- 15 Hydraulic lines
- 5 16 Rectangular frame
- 17 Mold support frame
- 18 Mold support surfaces

[Continuation of Reference Character List]

- 19 Median planes of the cast strands
- 10 20 Suspension element
- 21 Double-arm lever
- 21a Lever end
- 21b Lever end
- 22 Suspension trough
- 15 23 Adjusting device
- 24 Cooling medium discharge

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